Yellowstone Fisheries & Aquatic Sciences

Annual Report
2003

Thorofare Creek, October 2003.

Yellowstone National Park's Yellowstone Lake is home to the premier surviving inland cutthroat trout fishery in North America. Two significant threats to the native Yellowstone cutthroat trout, discovered over a five-year period during the 1990s, irreversibly altered the future of this thriving and diverse ecosystem. Without swift, continuing action, negative effects on this trout population—a keystone energy source for numerous mammal and bird species and a recreational focus for visitors—have the potential to produce ecosystemwide consequences.

Predatory, non-native lake trout were likely illegally introduced to the lake in 1988 and not discovered until 1994. They can consume 50–90 Yellowstone cutthroat trout per capita annually. Without heightened and maintained management efforts, they have the potential to decimate the Yellowstone Lake fishery in our lifetime. Lake trout also occupy an ecological niche unavailable to cutthroat-eating predators, imperiling the many species, such as grizzly bears, bald eagles, and river otters, that depend on the cutthroat for survival.

Whirling disease, a parasite that attacks the developing cartilage of young fish resulting in skeletal deformity, whirling behavior, abnormal feeding, and increased vulnerability to predation, was first detected in Yellowstone Lake in 1998, and in the Firehole River in 2000. This devastating disease further threatens already declining Yellowstone cutthroat trout populations. Although whirling disease is currently believed to be concentrated in the northern regions of the Yellowstone Lake watershed, several other tributaries have already been identified as at high risk.

In addition to native trout preservation, aquatics program goals include restoration of isolated but genetically pure westslope cutthroat trout, monitoring to track aquatic ecosystem health and expedite early warnings for other invasive exotic species, and encouragement of public involvement in various fisheries programs.

The stakes are high, raising the bar for innovative management and fundraising. The increased magnitude of the problems faced by the park's fisheries and the accelerated rate at which they are occurring are straining Yellowstone's resources. This annual report describes historic and continuing park aquatics programs as well as specific initiatives during 2003. It is a scientific call for action—action urgently needed to assure cutthroat trout survival and overall fishery health in Yellowstone National Park.

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Annual Report 2003

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Yellowstone cutthroat trout

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Front cover photo captions (left to right): NPS Aquatic Ecologist Jeffrey Arnold collecting aquatic macroinvertebrates; Arctic grayling from Grebe Lake, upper Gibbon River system (photo by Timothy Bywater); NPS volunteer Phillip Hurst radio tracking cutthroat trout on the upper Yellowstone River. Back cover photo captions (left to right): NPS stream fisheries crew conducting a survey of Slough Creek; native dragonfly flame skimmer along the Firehole River (photo by Jeffrey Arnold); non-native lake trout removed by gillnetting on Yellowstone Lake (photo by Patricia Bigelow). Facing page photo caption: NPS Fisheries Technician Barbara Rowdon with a lake trout removed from Breeze Channel, Yellowstone Lake (photo by Patricia Bigelow).

All photos in this report not otherwise marked are by Todd Koel.

Contents

Background

Created in 1872, Yellowstone National Park was for several years the only wildland under active federal management. Early visitors fished and hunted for subsistence, as there were almost no visitor services. At the time, park fishes were viewed as resources to be used—by sport anglers and to provide park visitors with fresh meals. Fish-eating wildlife, such as bears, ospreys, otters, and pelicans, were regarded as nuisances, and many were destroyed as a result.[1]

To supplement fishing and counteract this "destructive" consumption by wildlife, a fish "planting" program was established in Yellowstone. Early park superintendents noted the vast fishless waters of the park, and immediately asked the U.S. Fish Commission to "see that all waters are stocked so that the pleasure seeker can enjoy fine fishing within a few rods of any hotel or camp."[2] The first fishes from outside the park were planted in 1889–1890, and included brook trout in the upper Firehole River; rainbow trout in the upper Gibbon River; and brown trout and lake trout in Lewis and Shoshone lakes.[3] During the park's early history, stocked fisheries were extremely important. The harvest-oriented fish management program accounted for the planting of over 310 million fish in Yellowstone between 1881 and 1955. In addition, from 1889 to 1956, some 818 million eggs were stripped from Yellowstone trout and shipped throughout the United States.[4]

Largely due to these activities in Yellowstone National Park and the popularity of its fisheries,

NPS PHOTO

Planting of hatchery fish in a Yellowstone National Park stream in 1922.

NPS PHOTO

U.S. Fish and Wildlife Service personnel removing fish from a Yellowstone Lake gillnet in 1981.

recreational angling became a long-term, accepted use of national parks throughout the country. In Yellowstone, fisheries management, as we understand the term today, began with the U.S. Army and was assumed by the National Park Service in 1916. Fish stocking, data gathering, and other monitoring activities began with the U.S. Fish Commission in 1889, were continued by the U.S. Fish and Wildlife Service until 1996, and have been the responsibility of the National Park Service since 1996.

Because 40% of Yellowstone's waters were once fishless, the stocking of non-native fishes has had profound ecological consequences.[5] The more serious of these include displacement of intolerant natives such as westslope cutthroat trout and grayling, hybridization of Yellowstone and westslope cutthroat trout with each other and with non-native rainbow trout, and, most recently, predation of Yellowstone cutthroat trout by non-native lake trout. Over the years, National Park Service management policies have drastically changed to reflect new ecological insights, as highlighted in the Leopold Report of 1963.[6] Subsistence use and harvest orientation once guided fisheries management. Now, maintenance of natural biotic associations or, where possible, restoration to pre-European conditions have emerged as primary goals.

A perceived conflict exists in the National Park Service mandate that states the people will "use and enjoy," and also "protect and preserve" our pristine, natural systems.[7] To date, we know of 18 fish species or subspecies in Yellowstone National Park; 13 of these are considered native (they were known to exist in

park waters prior to Euro-American settlement) and five were introduced (non-native or exotic; see Appendix i).[8] Fisheries management efforts in Yellowstone are currently focused on preserving native species, while allowing for use of fisheries by visiting anglers through catch-and-release regulations. As our primary mission is the preservation of natural ecosystems and ecosystem processes, we will not emphasize maintenance of established non-native fish stocks. Along with native fish preservation, our Fisheries and Aquatic Sciences Section (Aquatics Section) activities include native fish restoration, stream and lake inventory and monitoring, and an emphasis on aquatic ecosystem health including water quality and macroinvertebrate monitoring of lakes and streams to serve as an early warning for advancing invasive exotic species.

Fisheries authority David Starr Jordan produced this map of Yellowstone waters in 1889, showing the large portion of the western side of the park as an AREA WITHOUT TROUT, *in anticipation of the extensive stocking program that followed. (From Baron W. Evermann, Report on the Establishment of Fish Cultural Stations in the Rocky Mountain Region and Gulf States, U.S. Government Printing Office, 1892).*

2003 Summary

The 2003 field season came to a close in early November, marking the end of the first decade of fieldwork since lake trout were discovered in Yellowstone Lake (Figure 1). This was a record year, as more than 18,000 of the non-native predators were killed to preserve our remaining native Yellowstone cutthroat trout of this system. Because each of the non-native lake trout would have consumed many cutthroat trout each year, the gillnetting effort has saved a tremendous number of cutthroat trout; 75,000 lake trout have been killed by gillnetting since they were first discovered in 1994. The angling community has also joined forces and has been contributing to a significant removal of lake trout from Yellowstone Lake each year. The result is a lake trout population that is suppressed and showing some signs of it. Catch per unit of effort for lake trout remains very low, and the average length of spawning adult lake trout continues to decline each year.

The number of Yellowstone cutthroat trout migrating upstream at Clear Creek, a major Yellowstone Lake spawning tributary, was only 3,432; the fewest to migrate upstream since 1959, just after loss of these fish due to overharvest of eggs by hatchery operations in the park. Similar results have been documented at many other, smaller spawning tributaries. Within Yellowstone Lake, cutthroat trout abundance, as indicated by the fall gillnetting program, suggested an increase in fish densities. The average number of cutthroat trout caught per net increased slightly from 6.1 to 7.4—the first encouraging signal in many years of sampling by this program.

Intensive research on whirling disease continues, with efforts focused on the Yellowstone River near Fishing Bridge, Pelican Creek (where the disease is most severe), and Clear Creek. Monitoring for spread of this exotic parasite also continues on streams with

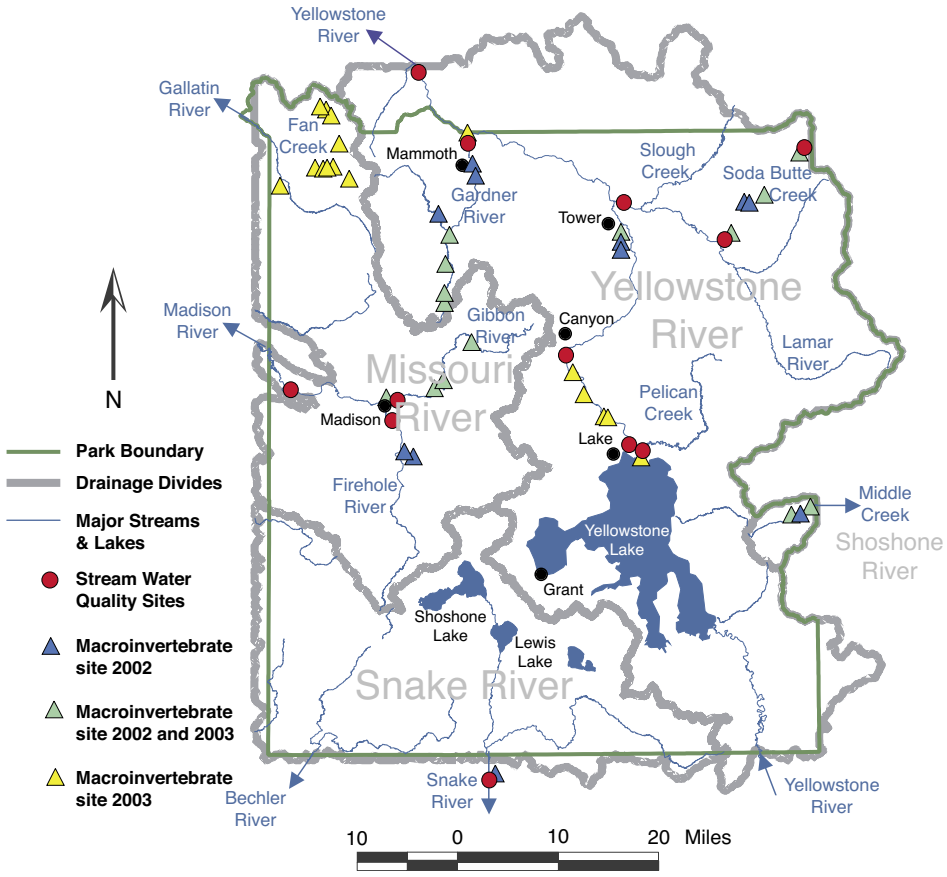

Figure 1. Major surface waters of Yellowstone National Park with 12 stream sites established for long-term monitoring of water quality and all sites sampled for macroinvertebrates 2002–2003. Labels for Fan Creek and Soda Butte Creek indicate locations, but streams are not shown.

similar drainage morphology to Pelican Creek, such as Beaverdam, Trail, Chipmunk, and Grouse creeks, and the upper Yellowstone River. Intensive searches for upstream-migrating adults and wild-reared fry over the past two years indicate that the Yellowstone cutthroat trout spawning population of Pelican Creek has been completely lost. Once numbering in the tens of thousands of fish, this loss has certainly contributed to the overall decline of cutthroat trout of the Yellowstone Lake ecosystem.

New research focusing on the status and life history strategies of cutthroat trout in the Yellowstone River and its tributaries upstream of Yellowstone Lake was initiated in 2003. This was the first survey of fishes in this region of the park, even though fisheries investigations have been occurring in Yellowstone since the late 1800s. The waters of this region likely support significant numbers of spawning cutthroat trout from Yellowstone Lake. Results will help managers understand the status and dynamics of cutthroat trout in this remote wilderness, and the contribution of this system to the overall cutthroat trout population of Yellowstone Lake.

Results in 2003 suggested that westslope cutthroat trout of North Fork Fan Creek are now hybridized with non-native rainbow trout. Intensive field investigations were completed to acquire additional samples for genetic testing. Work was also completed on amphibian occurrence, macroinvertebrate communities, habitat characteristics, and geology at the location of a potential barrier to additional invasion by harmful non-native fish species.

Native Yellowstone cutthroat trout population abundance and structure at Slough Creek remains excellent following several years of intense pressure on this stream by visiting anglers. Recent 2001–2003 survey data, when compared to information collected in 1987–1989, suggests that there has been no real change in densities or sizes of fish over this period. Of major significance was the documentation of non-native and potentially hybridizing rainbow trout in the first and second meadows of Slough Creek this year. It is unknown how these fishes moved above the barrier of Slough Creek near the campground, although rainbow trout are abundant in lower Slough Creek and in the Buffalo Fork.

The ecological health of aquatic systems in Yellowstone National Park continues to be monitored intensively. The quality of the park's surface waters are monitored biweekly at 12 fixed sites located near the confluences of major streams and rivers (Figure 1). The physical and chemical characteristics of Yellowstone Lake are monitored seasonally to assist the targeting of non-native lake trout. Macroinvertebrates continue to be sampled using regionally standardized methods to allow for easy comparison of data among agencies. Results are being used to assist with the development of Vital Signs Monitoring protocols for the Greater Yellowstone Network. A study was also completed which provided some of the first information on the effects of snowmobile emissions on the quality of snowmelt runoff in the park.

Brian Ertel, NPS fisheries technician, listening for a radio-tagged cutthroat trout in the upper Yellowstone River.

Over 54,000 special use fishing permits were issued in 2003. Anglers fished 2.75 hours per day during typical fishing trips in the park. Single-day anglers reported catching at least one fish 78% of the time, and on average landed almost one (0.89) fish per each hour of fishing. Native cutthroat trout remained the most sought-after and caught fish species, making up 59% of the total catch, followed distantly by rainbow trout 15%, brown trout 9%, brook trout 8%, whitefish and lake trout each 4%, and grayling 1%. Yellowstone Lake remains the most popular destination for anglers that come to the park.

Public involvement with the Aquatics Section continues to greatly increase, primarily through the incorporation of many volunteers. In 2003 alone, 98 volunteers dedicated 4,041 hours of their time to our projects. A highlight of the year was the continuation of the Yellowstone Volunteer Flyfishing Program, in which volunteer anglers from across the United States participated in several specific fisheries projects throughout the park. Information acquired by volunteers is being used to assess the status of fisheries in many waters of Yellowstone.

Yellowstone Cutthroat Trout Preservation

Yellowstone Lake and its tributaries represent the majority of undisturbed natural habitat and the home to the last stronghold of remaining genetically pure Yellowstone cutthroat trout (*Onchorhynchus clarki bouvieri*).[9] Now faced with pressure by non-native and exotic invaders and effects of three continuous drought years, the Yellowstone Center for Resources and Aquatics Section consider the preservation of this subspecies a top management and research priority. Ecosystem-level degradation is a possibility if the cutthroat trout population of Yellowstone Lake is allowed to decline.[10]

Data collected in 2003 provided some of the first evidence in several years that the Yellowstone cutthroat trout population may be responding positively to efforts to remove non-native lake trout.

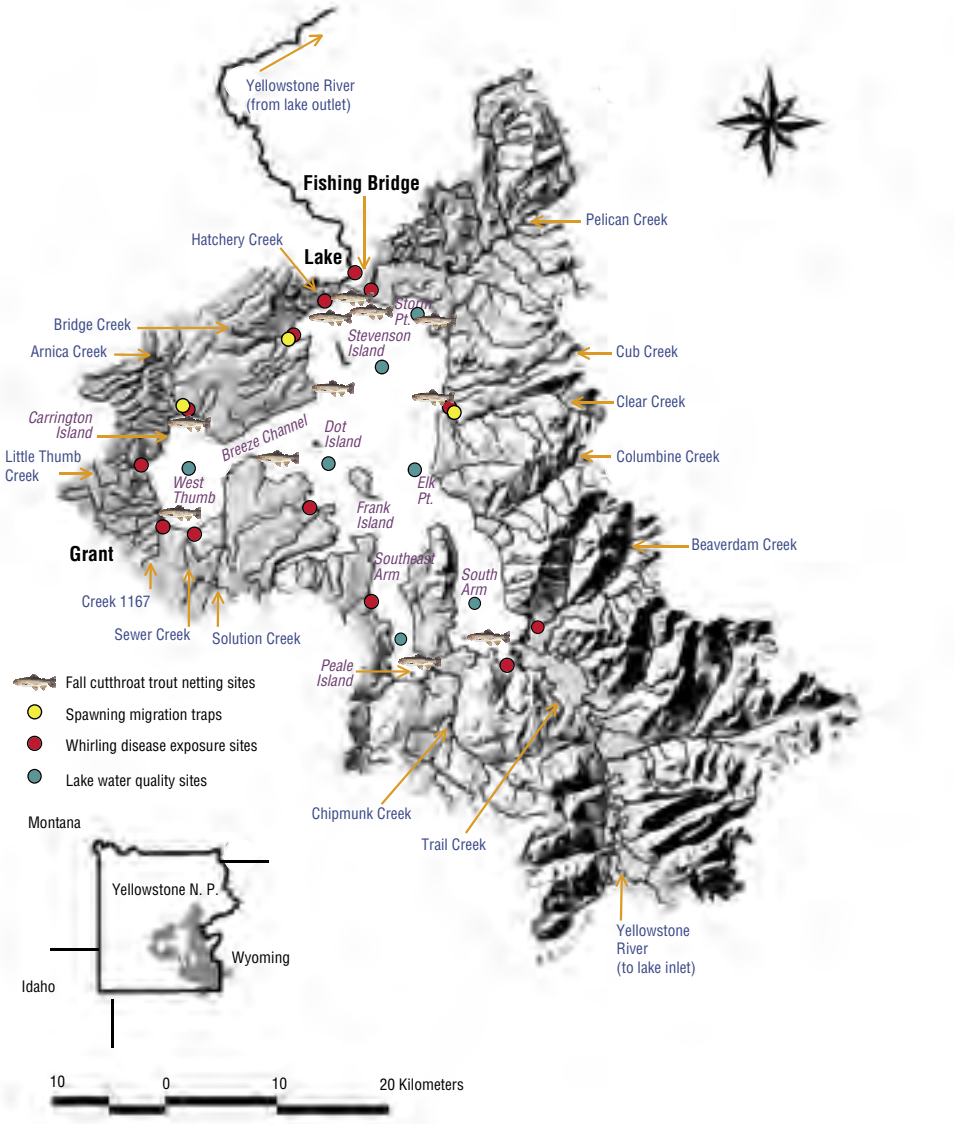

Figure 2. Yellowstone Lake and several major tributary drainages within Yellowstone National Park.

Maintaining Long-term Monitoring Programs

Annual assessment of the Yellowstone cutthroat trout population of Yellowstone Lake has been conducted by counts of upstream-migrating spawners at Clear Creek, Bridge Creek, and Arnica Creek; by dipnetting adult spawners at LeHardys Rapids; and by a netting program on the lake conducted during September each year.

Using multi-mesh-size gillnets set in shallow water at 11 sites throughout Yellowstone Lake, the Aquatics Section has been able to collect valuable cutthroat trout population information over time (Figure 2). Data collected in 2003 provided some of the first evidence in several years that the Yellowstone cutthroat trout population may be responding positively to efforts to remove non-native lake trout (*Salvelinus namaycush*) from Yellowstone Lake. An average of 7.4 fish were collected per net in 2003, up from 6.1 fish per net in 2002 (which was the lowest point recorded since the lake netting program began in 1969; Figure 3).[11] Prior to 2003, the reduction in catch had been 0–21% each year (averaging 11% per year) since 1994, the year lake trout were first discovered in Yellowstone Lake.[12]

Examination of length-frequency data from the fall netting survey has indicated an annual, continuous loss of adult cutthroat trout numbers in Yellowstone Lake (Figure 4). Entire age classes are virtually missing from the lake population. In 2003, few fish between the lengths of 300 and 430 mm were caught. Historically, most cutthroat trout noted in spawning tributaries such as Clear Creek and at LeHardys Rapids of the Yellowstone River have fallen in this size range.[13] Despite this, we see an apparent increase in juvenile cutthroat trout in recent years (2001–2003) as encouraging, and an additional signal that the lake trout removal program's effects may be significant, making a major contribution to the preservation of Yellowstone cutthroat trout. The South Arms of Yellowstone Lake may continue to act as refuges for cutthroat trout due to the low numbers of lake trout found there.[14]

The recent Yellowstone cutthroat trout population decline also remains evident in total numbers of upstream-migrating cutthroat trout at Clear Creek, a major spawning tributary on the lake's eastern side (Figure 3). A total of only 3,432 upstream and 1,576 (46%) downstream migrating cutthroat trout were counted at Clear Creek during May–July 2003. The upstream count was down from 6,613 in 2002, and was the lowest count since 1959, when only 3,353 cutthroat trout migrated upstream at Clear Creek (a year that closely followed the discontinuation of egg-taking operations on Yellowstone Lake). A fish counting station was also operated on Bridge Creek, a small northwestern tributary, where a total of 86 fish were counted migrating upstream and 46 (53%) were counted migrating downstream from late April through mid-June 2003. The number of spawning cutthroat trout continues to decline by more than 50% annually in Bridge Creek, and has decreased by over 97% since counts began in 1999.

Dan Mahony, NPS fisheries biologist, preparing the Clear Creek spawning migration trap.

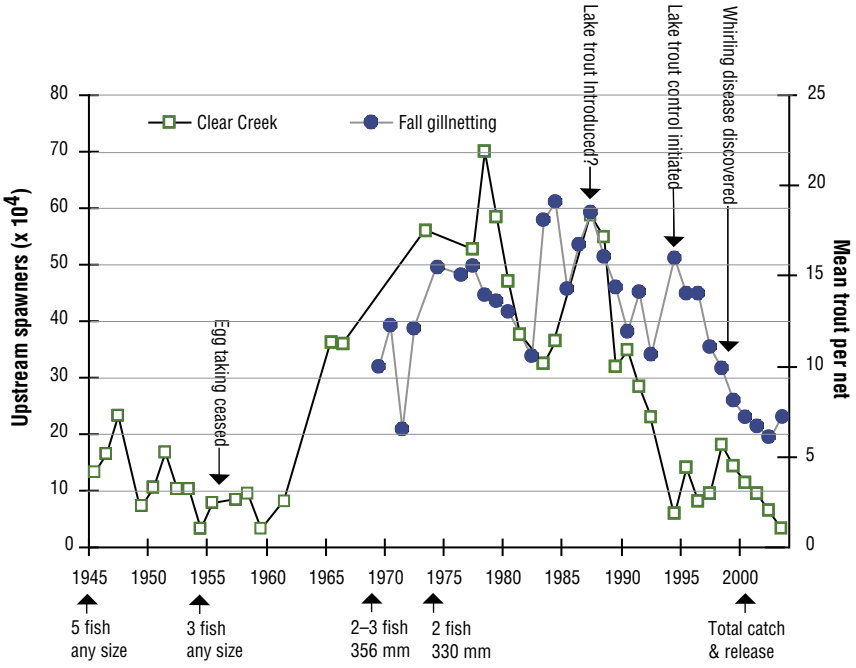

Figure 3. Total annual number of upstream-migrating Yellowstone cutthroat trout at Clear Creek and mean number of cutthroat trout collected per net by fall gillnetting on Yellowstone Lake. Arrows indicate dates of changes in sportfishing restrictions and other significant events, including the likely year for lake trout introduction as indicated by otolith microchemistry.

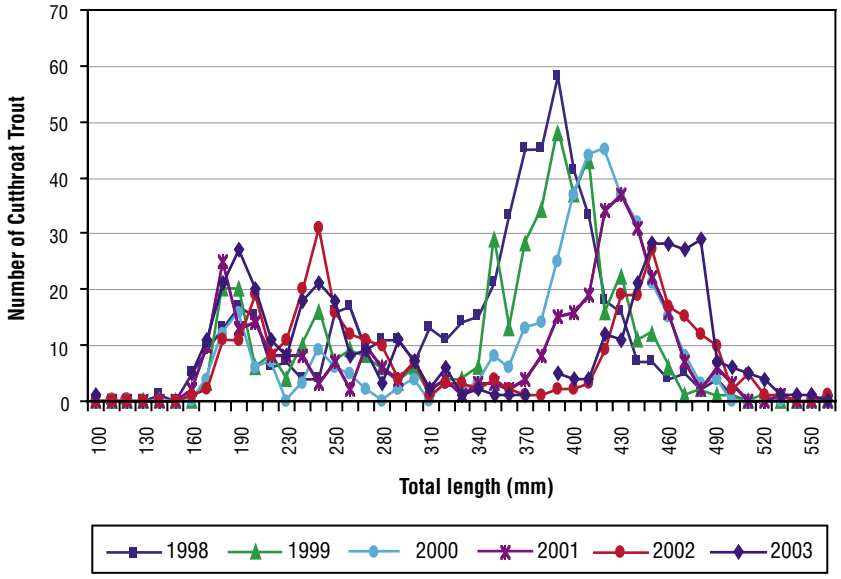

Figure 4. Length-frequency data collected from Yellowstone cutthroat trout, Yellowstone Lake, during fall netting assessments, 1998–2003. Note the severe decline in adults greater than 300 mm over time. Also note an increase in juveniles in 2002–2003.

The cumulative effect of the 2001–2003 drought in the intermountain west, and impacts by non-native/ exotic species have brought this precious population to its knees.

Yellowstone cutthroat trout population decline in recent times began during the years of drought and great fires of the late 1980s (Figure 3). The cumulative effect of the 2001–2003 drought in the intermountain west (resulting in extremely low stream flows and elevated water temperatures in Yellowstone National Park), and impacts by non-native/ exotic species have brought this precious population to its knees. Hope for sustaining the Yellowstone cutthroat trout population has come in the form of a large, dedicated crew of National Park Service and volunteer staff, with efforts aimed at suppressing the prolific and aggressive non-native lake trout population.

Removal of Non-native Lake Trout from Yellowstone Lake

Following the discovery of lake trout in Yellowstone Lake in 1994, efforts have continued to intensify to counteract this non-native threat.[15] Each year, gillnet operations staff have improved their knowledge of lake trout seasonal distribution patterns and their ability to target lake trout while avoiding bycatch of native Yellowstone cutthroat trout. In 2003, the ratio of lake trout killed to cutthroat trout sacrificed was very acceptable (0.11 cutthroat trout lost for every lake trout killed).

Over 18,000 lake trout from Yellowstone Lake were terminated in 2003, using 20,657 net units (one net unit = 100 m of net set over one night). Small mesh (19–44 mm mesh size) gillnets were placed on the lake bottom in water typically 50–75 m deep. As in past years, lake trout carcasses were returned to the lake to avoid removing nutrients from this relatively nutrient-poor system. On a typical day during the open water season on Yellowstone Lake, over 10 miles of gillnet were in place fishing for lake trout. Using the efficient National Park Service gillnetting boat, the *Freedom*, and at least one other vessel on most days, the gillnetting effort has increased to greater than twelve-fold over the 1999 level (Figure 5). Catch rate (catch per unit of effort) in 2003 remained very low (0.87), and was similar to that of 2002; catch rate has declined dramatically since 1998, when an average of 5.51 lake trout per net unit were caught each night.

In 2003, gillnetting crews identified a significant lake trout spawning location near the West Thumb Geyser Basin. This spawning location, along with areas near Carrington Island, Solution Creek, and Breeze Channel, is heavily gillnetted from late August through September using shallow-set (5–15 m depth), large mesh gillnet (51–70 mm mesh size) sets of short duration to avoid cutthroat trout bycatch and mortality. The average total length of lake trout caught near the spawning areas continued to indicate an overall decrease in the length of sexually mature lake trout (Figure 6). However, the total number of spawning lake trout caught in 2003 was much higher than in previous

BRIAN ERTEL

Large spawning female lake trout collected using gillnets set for short duration at night in the West Thumb of Yellowstone Lake.

years due to the discovery of the new spawning location.

Since 1994, more than 75,000 lake trout have been terminated in Yellowstone Lake by our gillnetting program. The majority of these fish have been in the West Thumb and Breeze Channel, where most of the gillnetting effort is concentrated. Bioenergetics modeling (estimates of how many cutthroat trout a lake trout potentially consumes) suggests that an average mature lake trout will consume 41 cutthroat trout per year.[16] Thus, the control project has saved a large number of cutthroat trout from lake trout predation. The recent decline in catch rate of lake trout throughout the season and overall reduction in average length of spawning fish are positive indications that gillnetting operations are exerting significant lake trout mortality in this system.

Although recent numbers from the lake trout removal program are encouraging, the effort must continue to keep this non-native predatory population in check. Lake trout densities in the West Thumb remain high and a serious threat to the Yellowstone cutthroat trout. Model simulations indicate that a 60% or greater decline in the cutthroat population could be expected within 100 years if the lake trout population were permitted to grow uncontrolled.[17] We remain unsuccessful at developing a technique to remove lake trout in the mid-size range (400–600 mm total length). This component of the population coexists spatially with our cutthroat trout population, making it impossible to effectively gillnet them without also incurring an unacceptable mortality rate in cutthroat trout. In 2003, fisheries staff deployed large fyke nets at lake trout spawning locations. Fyke nets are generally a non-lethal collection method and, if effective, would allow live release of any cutthroat trout also caught. Unfortunately, few lake trout were taken using

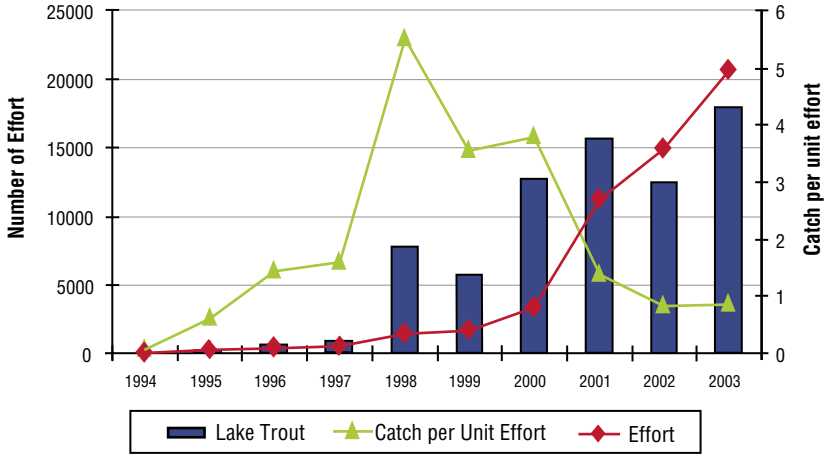

Figure 5. Total number of lake trout removed by gillnetting in Yellowstone Lake with total gillnetting effort and catch per unit of effort, 1994–2003. Each unit of effort represents 100 meters of gillnet set over one night.

More than 75,000 lake trout have been killed by gillnetting since they were first discovered in 1994.

BRIAN ERTEL

The reproductive potential of spawning lake trout is very high.

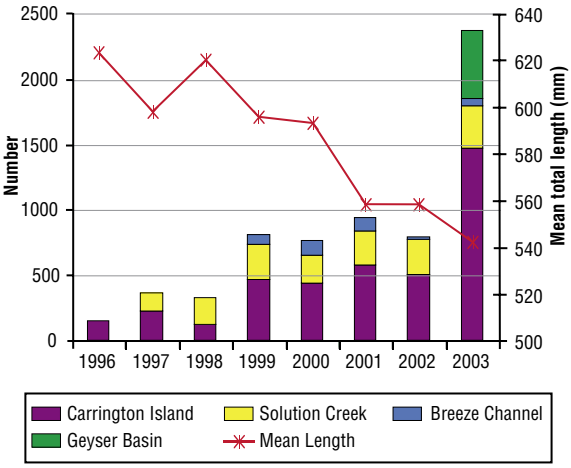

Figure 6. Total number and overall mean total length of lake trout gillnetted from or near spawning areas, Yellowstone Lake, 1994–2003.

this method. We will continue to investigate new methods to target this segment of the population before the fish reach full maturity, and perhaps pioneer new spawning sites.

Understanding the Effects of Whirling Disease

KENDRA KINNIN

The microscopic worm Tubifex tubifex *is the alternate host for the whirling disease life cycle and a focus of study for understanding this disease in Yellowstone.*

Recent work on *Myxobolus cerebralis*, the parasite that causes whirling disease, has shifted to intensive research on the apparent origin and potential source of infection in the Yellowstone River near Fishing Bridge, Pelican Creek (where infection is most severe), and Clear Creek. Infection risk of native Yellowstone cutthroat trout is being related to *Tubifex tubifex* (the alternate host for *M. cerebralis*) presence, abundance, and infection, and the environmental characteristics of tributary basins. Severe infection has been documented through exposure of Yellowstone cutthroat trout fry to the trail crossing (near the old bridge site) far upstream on Pelican Creek; the parasite likely extends upstream from there.

Disease spread is being evaluated through monitoring of tributaries with similar basin morphology to Pelican Creek, as recent survey results indicate that the spawning cutthroat trout population of this stream (which once numbered in the tens of thousands of migrating fish) has been completely lost. Rigorous netting for migrating adult cutthroat trout in this stream in 2002 and 2003 turned up only a handful of fish. In addition, intensive searches for wild-reared cutthroat trout fry resulted in none found in 2002, and only 9 in 2003. Establishment of *M. cerebralis* in Pelican Creek has contributed to the recent severe decline in the total Yellowstone Lake population of native Yellowstone cutthroat trout.

There have been significant differences among annual and within-season variation in infection prevalence and severity of exposed fry at Pelican Creek and other infected streams. The host–parasite and ecological interactions in this system have been unclear. The *T. tubifex* genetic strain has been considered moderate in its potential to produce triactinomyxons, and other myxozoans exist in the lake basin and are also infecting *T. tubifex* and (unknown) fish host(s) there.[18] *M. cerebralis* apparently tolerates, and has been highly successful in significantly higher mean water temperatures than those documented for most other systems. Many areas of Pelican Creek are thermally heated and remain without ice cover throughout the winter; these unique geothermal influences may have concentrated tubificids and *M. cerebralis* infection. If additional information regarding locations of infected tubificids in Pelican Creek were known, management action could potentially be taken (especially if the distribution were highly clumped) to reduce *M. cerebralis* infection risk in this stream.

Although laboratory challenges and previous field studies elsewhere have suggested that Yellowstone cutthroat trout are only moderately susceptible to *M. cerebralis* infection, results of our research indicate that this subspecies/strain may be very susceptible.[19] Additional work should be done to compare the *M. cerebralis* resistance among potentially unique cutthroat trout from isolated populations. Perhaps inherent resistance to this parasite exists, and could be used to support ongoing broodstock development programs for conservation efforts in Yellowstone National Park and the neighboring states.

NPS fisheries crew checking nets set for upstream migrating cutthroat trout in Pelican Creek.

Hydroacoustic Surveys to Document Population Change

Surveys using state of the art hydroacoustic equipment, for estimating fish densities, were conducted throughout Yellowstone Lake twice during the 2003 field season. Partial surveys were completed three additional times to compare seasonal distribution of lake trout. Thorough analysis of hydroacoustic data collected this past field season will allow us to determine areas of high density, size ranges of fish in given areas, and depths at which fish reside. New graduate-level research has been initiated to relate these data with detailed bathymetry data produced by the U.S. Geological Survey.[20] This research will allow us to identify specific lake areas where we need to either increase or decrease our lake trout gillnetting effort and will improve program efficiency. This technology will also allow for evaluation of the effectiveness of our removal efforts by estimating lake trout and cutthroat trout population densities annually.

Status of Cutthroat Trout in the Upper Yellowstone River

Although fisheries investigations have been occurring in Yellowstone National Park since just after its creation in the late 1800s, there has never been a survey of the Yellowstone River and its vast array of remote tributaries upstream of Yellowstone Lake. With the recent threats of lake trout and whirling disease to cutthroat trout in Yellowstone Lake, determination of cutthroat trout status in this region became crucial for purposes of making future management recommendations regarding this system. In 2003, the Aquatics Section and staff from the Wyoming Game and Fish Department initiated a fisheries assessment of the upper Yellowstone River. The study will determine movements of adult Yellowstone cutthroat trout during their spawning migration in the Yellowstone River and several of its tributaries. We also will determine if any resident populations exist in the drainage.

Radio transmitters were implanted in 62 adult Yellowstone cutthroat trout in the Yellowstone River and several of its tributaries. Tag life is expected to be two years, with the tags operating for six months of the year (May–November). Tagged fish were monitored with weekly tracking flights and several trips to groundtruth what we were learning from the air. Surveys to locate fish that moved into Yellowstone Lake were conducted via boat.

Tagged Yellowstone cutthroat trout moved substantial distances through the summer of 2003. Fish as far upstream as Thorofare Creek, south of the park boundary, were found in the mouth of the Yellowstone River at Yellowstone Lake just a few weeks later, a distance of 31.5 stream miles. Signals were also received in Yellowstone Lake at Clear Creek and the Molly Islands, and one fish was captured by an angler at Breeze Point. The majority of fish tagged moved into Yellowstone Lake as the season passed. A few of the fish tagged in the upper reaches of the drainage stayed in the river, but all fish moved downstream from the initial tagging position. There were five known mortalities of tagged fish, including one angler-caused (outside the park boundary), two consumed by white pelicans (tags were recovered on the Molly Islands), and two with cause of mortality unknown. The study is planned to continue for several more years. The final tagging operations will take place this summer, with monitoring continuing for a minimum of two field seasons.

Phillip Hurst, NPS volunteer, assisting with radio telemetry on the upper Yellowstone River.

There has never been a survey of the Yellowstone River and its vast array of remote tributaries upstream of Yellowstone Lake.

Westslope Cutthroat Trout Restoration

Population Surveys

Since 1983, park fishery personnel have been collecting information about the westslope cutthroat trout (*Onchorhynchus clarki lewisi)* residing in Fan Creek, a tributary of the Gallatin River (Figure 1). This native trout was historically abundant in both the Gallatin and Madison river basins, but recent genetic surveys indicated that the most likely concentrations of genetically pure westslope cutthroat trout were located only in the headwater sections of Fan Creek. Although five genetically pure westslope cutthroat trout were collected near the confluence of Fan Creek and the Gallatin River in 1997, subsequent samplings upstream suggest that the population has hybridized with Yellowstone cutthroat trout, rainbow trout (*Onchorhynchus mykissi)*, or both, in most of the Fan Creek mainstem.

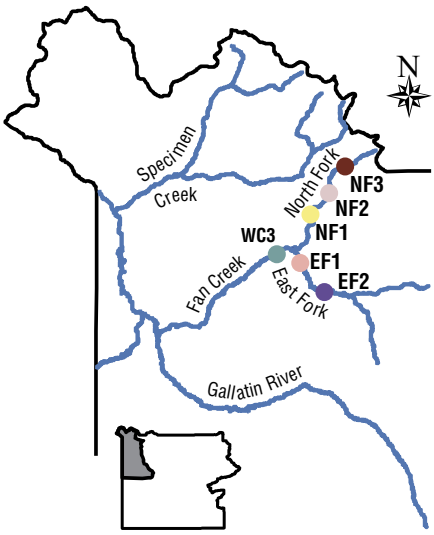

Figure 7. Reaches on Fan Creek sampled by electrofishing for westslope cutthroat trout, 1998–2003.

In order to obtain more detailed information about the remaining westslope cutthroat trout populations in the park, population estimates have been conducted annually since 1998 at several 100-m sections in the mainstem and each of the two forks of Fan Creek (Figure 7). Several years of sampling have shown that despite considerable annual variability, abundance of westslope cutthroat trout in much of the Fan Creek watershed is relatively low (<500 individuals per kilometer). At the low gradient sites (North Fork 1 and both of the East Fork sections), estimated density of cutthroat declined by about 50% from the maximum observed in 2001 (Figure 8). In contrast, estimated westslope cutthroat trout abundance in the upper two North Fork sections containing large amounts of woody debris was consistently higher than that observed in the downstream areas.

Westslope cutthroat trout captured from the North Fork in 2003 were mostly small fish (<200 mm total length), but two caught near the confluence of the North and East forks were 381 mm long. Preliminary length frequency analyses suggested that at least three, and possibly four, distinct year classes of cutthroat trout were present in the North Fork Fan Creek in 2003. As in previous years, mottled sculpin (*Cottus bairdi*), another native species, were collected at all sites except the two upstream sections of the North Fork Fan Creek. Where they occurred, sculpins were typically so abundant that their estimated biomass was higher than that of the westslope cutthroat trout in most years, even though most of the sculpins were quite small (<75 mm in length).

Genetics Surveys

Based on results from 1997 and 1998, the Aquatics Section has concentrated more recent genetic inventories on Fan Creek populations. The apparent verification of a genetically pure population in the North Fork Fan Creek encouraged NPS managers to proceed with development of a broodstock in cooperation with Montana and Wyoming state fishery agencies for eventual restoration projects throughout the upper Missouri River watershed.

To be considered a donor population, secondary verification of genetic status was recommended. To meet these requirements, tissue samples from 60 cutthroat trout each from 2001 and 2002 were analyzed in May 2003. Preliminary analyses suggested that the previously pure population in North Fork Fan Creek had recently become hybridized with rainbow trout. With this new information, plans for collecting gametes on site in Fan Creek were temporarily cancelled. Additional samples (>150 fish) were obtained in 2003, but they have yet to be analyzed. Because these samples were collected from a variety of locations in the watershed, it is hoped that these additional analyses will not only detail the amount of recent hybridization in the population, but also provide an accurate account of the spatial distribution of the hybridized (and remaining pure) cutthroat trout.

Restoration Potential

Unlike many other areas within its historical range, habitat degradation and excessive harvest rates by anglers do not appear to be the primary reason for the decline of westslope cutthroat in Yellowstone National Park. Rather, the extensive stocking and subsequent establishment of populations of non-native competing species (brown trout [*Salmo trutta*], and interbreeding rainbow trout and Yellowstone cutthroat trout) during the first half of the twentieth century have led to a serious reduction in the park's resident westslope cutthroat trout. Our electrofishing, genetic, and radiotagging surveys of the past five years have demonstrated that the once abundant westslope cutthroat trout is now confined to a single, small tributary in the northwest corner of the park.

A recent determination by the U.S. Fish and Wildlife Service that westslope cutthroat trout do not currently warrant classification as a "listed" species suggests that this native fish will only be protected if federal and state agencies continue to pursue strong conservation measures.[21] Despite results of recent genetics analyses, the North Fork Fan Creek population has high genetic integrity and should be considered an "at risk" population. Although these fish are protected from habitat and angler impacts, evidence from our surveys reveals that these fish could be affected by non-native fish species. The capture of non-native brown trout each year indicates that there are no barriers to prevent upstream migration of non-native species into the headwater cutthroat trout populations. Complete protection of the North Fork Fan Creek westslope cutthroat trout population requires that they be permanently isolated from invading species.

North Fork Fan Creek.

To meet our restoration goals, additional information needed for preparation of an environmental assessment was collected in 2003. Aquatics Section staff completed habitat assessments, water quality sampling, and macroinvertebrate collections of the Fan Creek system this year. With the assistance of the park's geology staff, an onsite survey was conducted to ensure that the preferred site for the migration barrier on the mainstem of Fan Creek was the most appropriate hydrological site. In addition to our annual population surveys, Aquatics Section staff provided logistical support for Idaho State University researchers conducting amphibian surveys at several headwater lakes in the Gallatin River basin that could potentially be used for broodstock development of verified pure westslope cutthroat trout.

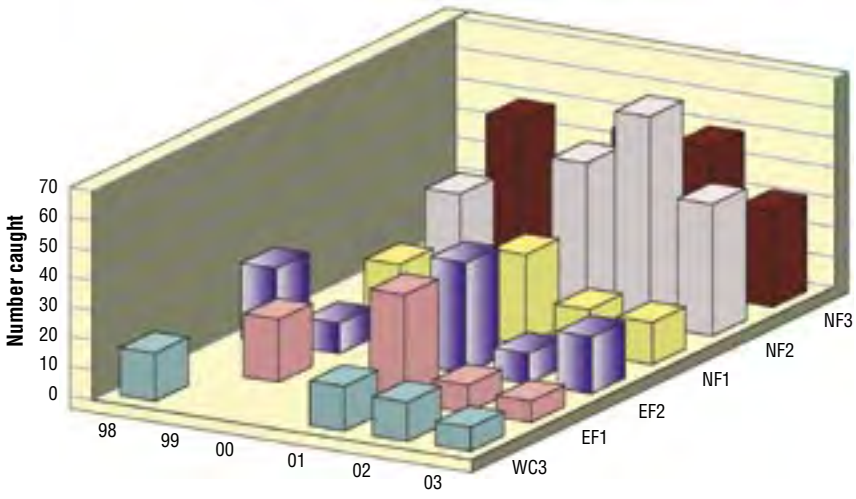

Figure 8. Number of westslope cutthroat trout collected by electrofishing from reaches on the Fan Creek mainstem (WC3), East Fork (EF1 and EF2), and North Fork (NF1, NF2, and NF3; see figure 7).

Stream Fishery Surveys and Fish Health

Population Surveys

The abundance and size structure of the Yellowstone cutthroat trout population of Slough Creek have not changed since the stream was last sampled in 1989.

This year we completed a multi-year population assessment of Yellowstone cutthroat trout in Slough Creek, prompted by concerns of perceived damage to riparian areas or the fish population arising from increased angler use. In the mid-1990s, annual angler use occasionally exceeded 25,000 angler days per year as Slough Creek became one of the most popular angling areas in the park, particularly in the meadow areas upstream from the campground, even though hourly catch rates were often below one fish per hour. During the drought periods of the past several years, anecdotal information indicated that additional anglers were fishing at Slough Creek as a substitute for other streams that were temporarily closed due to high instream water temperatures. With this information as background, we sampled some of the more heavily used portions of Slough Creek. Our electrofishing results indicated that there is little evidence that the abundance or size structure of the Yellowstone cutthroat trout population has changed since the stream was last sampled in 1989 (Figure 9). Although high levels of angler use continued in this popular catch-and-release fishery, estimated abundance of adult cutthroat trout longer than 330 mm remains at several hundred fish per kilometer. The recent capture of several potentially hybridizing rainbow trout of spawning size in areas of pure Yellowstone cutthroat trout appears to represent a much more serious threat to the long-term persistence of this population than are the current levels of angler use.

Monitoring Associated with Road Reconstruction

Reconstruction of the primary park roads is a major management objective in Yellowstone National Park. Because many of these roads parallel streams to enhance the scenic quality of the visitor experience, road construction projects can potentially impact fish populations if excessive sediment is generated or improper design impedes fish passage through road culverts. In 2003, road reconstruction was initiated between Fishing Bridge and Canyon Junction, and on the Dunraven Pass road. Several streams used by spawning and resident Yellowstone cutthroat trout are located within these construction areas. Cutthroat trout

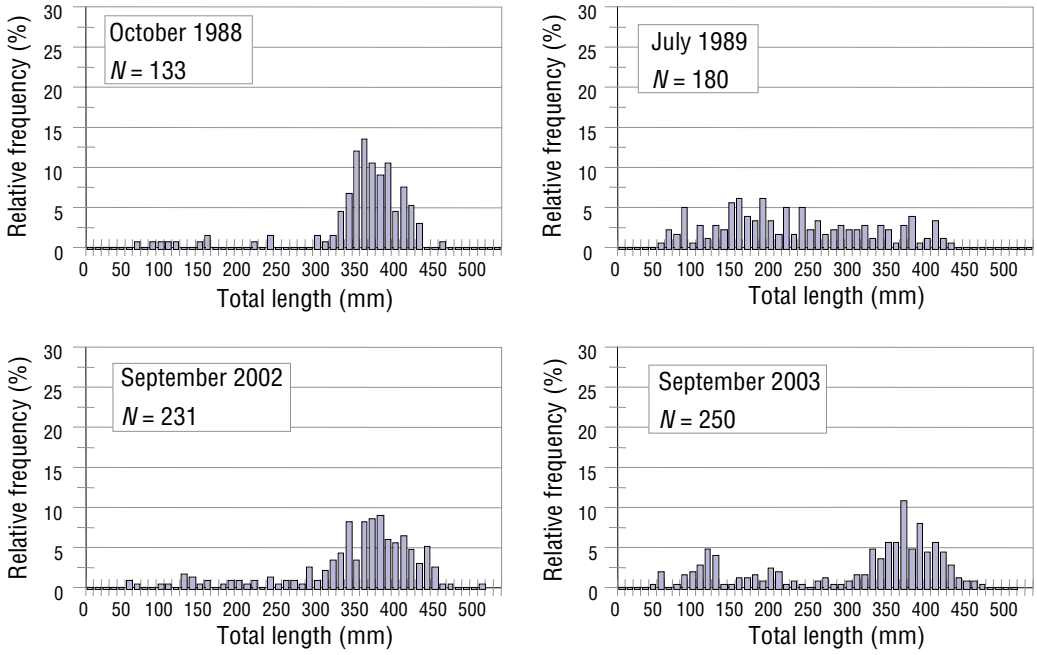

Figure 9. Relative length-frequency distributions (sample size = N) of Yellowstone cutthroat trout collected by boom-mounted electrofishing in the first meadow of Slough Creek, 1988–89, compared to 2002–03.